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And \bar{x} is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.99}$ is the t statistic for a 99% two-tailed confidence interval with $n-1$ degrees of freedom (from appendix A).

(b) *Certification reports.* (1) The requirements of § 429.12 are applicable to metal halide lamp ballasts; and

(2) Pursuant to § 429.12(b)(13), a certification report shall include the following public product-specific information: The minimum ballast efficiency in percent (%), the lamp wattage in watts (W), and the type of ballast (*e.g.*, pulse-start, magnetic probe-start, and non-pulse start electronic).

[76 FR 12451, Mar. 7, 2011; 76 FR 24780, May 2, 2011; 76 FR 46202, Aug. 2, 2011]

§ 429.70 Alternative methods for determining energy efficiency or energy use.

(a) *General.* A manufacturer of commercial HVAC and WH equipment, distribution transformers, and central air conditioners and heat pumps may not distribute any basic model of such equipment in commerce unless the manufacturer has determined the energy efficiency of the basic model, either from testing the basic model or from applying an alternative method for determining energy efficiency or energy use (AEDM) to the basic model, in accordance with the requirements of this section. In instances where a manufacturer has tested a basic model to validate the alternative method, the energy efficiency of that basic model must be determined and rated according to results from actual testing. In addition, a manufacturer may not knowingly use an AEDM to overrate the efficiency of a basic model. For each basic model of distribution transformer that has a configuration of windings that allows for more than one nominal rated voltage, the manufacturer must determine the basic model's efficiency either at the voltage at which the highest losses occur or at each voltage at which the transformer is rated to operate.

(b) *Testing.* Testing for each covered product or covered equipment must be done in accordance with the sampling plan provisions established in §§ 429.14

through 429.54 and the testing procedures in parts 430 and 431.

(c) *Alternative efficiency determination method (AEDM) for commercial HVAC and WH equipment—*(1) *Criteria an AEDM must satisfy.* A manufacturer may not apply an AEDM to a basic model to determine its efficiency pursuant to this section unless:

(i) The AEDM is derived from a mathematical model that represents the energy consumption characteristics of the basic model;

(ii) The AEDM is based on engineering or statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data; and

(iii) The manufacturer has substantiated the AEDM, in accordance with paragraph (c)(2) of this section.

(2) *Substantiation of an AEDM.* Before using an AEDM, the manufacturer must substantiate and validate the AEDM as follows:

(i) A manufacturer must first apply the AEDM to three or more basic models that have been tested in accordance with §§ 431.173(b) and 431.175(a). The predicted efficiency calculated for each such basic model from application of the AEDM must be within five percent of the efficiency determined from testing that basic model, and the predicted efficiencies calculated for the tested basic models must, on average, be within one percent of the efficiencies determined from testing such basic models; and

(ii) Using the AEDM, the manufacturer must calculate the efficiency of three or more of its basic models. They must be the manufacturer's highest-selling basic models to which the AEDM could apply and different models than those used to develop the AEDM (*i.e.*, different models than those used in paragraph (c)(2)(i) of this section); and

(iii) The manufacturer must test each of these basic models in accordance with § 431.173(b), and either § 431.174(b) or 431.175(a), whichever is applicable; and

(iv) The predicted efficiency calculated for each such basic model from application of the AEDM must be within five percent of the efficiency determined from testing that basic model,

and the average of the predicted efficiencies calculated for the tested basic models must be within one percent of the average of the efficiencies determined from testing these basic models.

(3) *Subsequent verification of an AEDM.* If a manufacturer has used an AEDM pursuant to this section,

(i) The manufacturer must have available for inspection by the Department records showing:

(A) The method or methods used;

(B) The mathematical model, the engineering or statistical analysis, computer simulation or modeling, and other analytic evaluation of performance data on which the AEDM is based;

(C) Complete test data, product information, and related information that the manufacturer generated or acquired under paragraph (c)(1) through (2) of this section; and

(D) The calculations used to determine the average efficiency and energy consumption of each basic model to which an AEDM was applied.

(ii) If requested by the Department, the manufacturer must perform at least one of the following:

(A) Conduct simulations to predict the performance of particular basic models of the commercial HVAC and WH product;

(B) Provide analyses of previous simulations conducted by the manufacturer;

(C) Conduct sample testing of basic models selected by the Department; or

(D) Conduct a combination of these.

(d) *Alternative efficiency determination method for distribution transformers*—A manufacturer may use an AEDM to determine the efficiency of one or more of its untested basic models only if it determines the efficiency of at least five of its other basic models (selected in accordance with paragraph (d)(3) of this section) through actual testing.

(1) *Criteria an AEDM must satisfy.*

(i) The AEDM has been derived from a mathematical model that represents the electrical characteristics of that basic model;

(ii) The AEDM is based on engineering and statistical analysis, computer simulation or modeling, or other analytic evaluation of performance data; and

(iii) The manufacturer has substantiated the AEDM, in accordance with paragraph (d)(2) of this section, by applying it to, and testing, at least five other basic models of the same type, *i.e.*, low-voltage dry-type distribution transformers, medium-voltage dry-type distribution transformers, or liquid-immersed distribution transformers.

(2) *Substantiation of an AEDM.* Before using an AEDM, the manufacturer must substantiate the AEDM's accuracy and reliability as follows:

(i) Apply the AEDM to at least five of the manufacturer's basic models that have been selected for testing in accordance with paragraph (d)(3) of this section, and calculate the power loss for each of these basic models;

(ii) Test at least five units of each of these basic models in accordance with the applicable test procedure and § 429.47, and determine the power loss for each of these basic models;

(iii) The predicted total power loss for each of these basic models, calculated by applying the AEDM pursuant to paragraph (d)(2)(i) of this section, must be within plus or minus five percent of the mean total power loss determined from the testing of that basic model pursuant to paragraph (d)(2)(ii) of this section; and

(iv) Calculate for each of these basic models the percentage that its power loss calculated pursuant to paragraph (d)(2)(i) of this section is of its power loss determined from testing pursuant to paragraph (d)(2)(ii) of this section, compute the average of these percentages, and that calculated average power loss, expressed as a percentage of the average power loss determined from testing, must be no less than 97 percent and no greater than 103 percent.

(3) *Additional testing requirements.* (i) A manufacturer must select basic models for testing in accordance with the following criteria:

(A) Two of the basic models must be among the five basic models with the highest unit volumes of production by the manufacturer in the prior year, or

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during the prior 12-calendar-month period beginning in 2003,¹ whichever is later;

(B) No two basic models should have the same combination of power and voltage ratings; and

(C) At least one basic model should be single-phase and at least one should be three-phase.

(ii) In any instance where it is impossible for a manufacturer to select basic models for testing in accordance with all of these criteria, the criteria shall be given priority in the order in which they are listed. Within the limits imposed by the criteria, basic models shall be selected randomly.

(4) *Subsequent verification of an AEDM.* (i) Each manufacturer that has used an AEDM under this section shall have available for inspection by the Department of Energy records showing:

(A) The method or methods used;

(B) The mathematical model, the engineering or statistical analysis, computer simulation or modeling, and other analytic evaluation of performance data on which the AEDM is based;

(C) Complete test data, product information, and related information that the manufacturer has generated or acquired pursuant to paragraph (d)(4) of this section; and

(D) The calculations used to determine the efficiency and total power losses of each basic model to which the AEDM was applied.

(ii) If requested by the Department, the manufacturer must perform at least one of the following:

(A) Conduct simulations to predict the performance of particular basic models of distribution transformers specified by the Department;

(B) Provide analyses of previous simulations conducted by the manufacturer;

(C) Conduct sample testing of basic models selected by the Department; or

(D) Conduct a combination of these.

(e) *Alternate Rating Method (ARM) for residential split-system central air conditioners and heat pumps—*

(1) *Criteria an ARM must satisfy.* The basis of the ARM referred to in § 429.16(a)(2)(ii) for residential central air conditioners and heat pumps must be a representation of the test data and calculations of a mechanical vapor-compression refrigeration cycle. The major components in the refrigeration cycle must be modeled as “fits” to manufacturer performance data or by graphical or tabular performance data. Heat transfer characteristics of coils may be modeled as a function of face area, number of rows, fins per inch, refrigerant circuitry, air-flow rate and entering-air enthalpy. Additional performance-related characteristics to be considered may include type of expansion device, refrigerant flow rate through the expansion device, power of the indoor fan and cyclic-degradation coefficient. Ratings for untested combinations must be derived from the ratings of a combination tested in accordance with § 429.16(a)(2)(i). The seasonal energy efficiency ratio (SEER) and/or heating seasonal performance factor (HSPF) ratings for an untested combination must be set equal to or less than the lower of the SEER and/or HSPF calculated using the applicable DOE-approved alternative rating method (ARM). If the method includes an ARM/simulation adjustment factor(s), determine the value(s) of the factor(s) that yield the best match between the SEER/HSPF determined using the ARM versus the SEER/HSPF determined from testing in accordance with § 429.16(a)(2)(i). Thereafter, apply the ARM using the derived adjustment factor(s) only when determining the ratings for untested combinations having the same outdoor unit.

(2) *Approval of an ARM.* (i) Manufacturers who elect to use an ARM for determining measures of energy consumption under § 429.16(a)(2)(ii)(B)(1) and paragraph (e)(1) of this section must submit a request for DOE to review the ARM. Send the request to: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program (EE-2J), Attention: Alternative Rating Methods (ARM) for Certification and Compliance, Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585-0121.

¹When identifying these five basic models, any basic model that does not comply with Federal energy conservation standards for distribution transformers that may be in effect shall be excluded from consideration.

(ii) Each request to DOE for approval of an ARM must include:

(A) The name, mailing address, telephone number, and e-mail address of the official representing the manufacturer.

(B) Complete documentation of the alternative rating method to allow DOE to evaluate its technical adequacy. The documentation must include a description of the methodology, state any underlying assumptions, and explain any correlations. The documentation should address how the method accounts for the cyclic-degradation coefficient, the type of expansion device, and, if applicable, the indoor fan-off delay. The requestor must submit any computer programs—including spreadsheets—having less than 200 executable lines that implement the ARM. Longer computer programs must be identified and sufficiently explained, as specified above, but their inclusion in the initial submittal package is optional. Applicability or limitations of the ARM (*e.g.*, only covers single-speed units when operating in the cooling mode, covers units with rated capacities of 3 tons or less, not applicable to the manufacturer's product line of non-ducted systems) must be stated in the documentation.

(C) Complete test data from laboratory tests on four mixed (*i.e.*, non-highest-sales-volume combination) systems per each ARM.

(1) The four mixed systems must include four different indoor units and at least two different outdoor units. A particular model of outdoor unit may be tested with up to two of the four indoor units. The four systems must include two low-capacity mixed systems and two high-capacity mixed systems. The low-capacity mixed systems may have any capacity. The rated capacity of each high-capacity mixed system must be at least a factor of two higher than its counterpart low-capacity mixed system. The four mixed systems must meet the applicable energy conservation standard in § 430.32(c) in effect at the time of the rating.

(2) The four indoor units must come from at least two different coil families, with a maximum of two indoor units coming from the same coil family. Data for two indoor units from the

same coil family, if submitted, must come from testing with one of the “low-capacity mixed systems” and one of the “high-capacity mixed systems.” A mixed system indoor coil may come from the same coil family as the highest-sales-volume-combination indoor unit (*i.e.*, the “matched” indoor unit) for the particular outdoor unit. Data on mixed systems where the indoor unit is now obsolete will be accepted towards the ARM-validation submittal requirement if it is from the same coil family as other indoor units still in production.

(3) The first two sentences of paragraph (e)(2)(ii)(C)(2) of this section do not apply if the manufacturer offers indoor units from only one coil family. In this case only, all four indoor coils must be selected from this one coil family. If approved, the ARM will be specifically limited to applications for this one coil family.

(D) All product information on each mixed system indoor unit, each matched system indoor unit, and each outdoor unit needed to implement the proposed ARM. The calculated ratings for the four mixed systems, as determined using the proposed ARM, must be provided along with any other related information that will aid the verification process.

(E) If request for approval is for an updated ARM, manufacturers must identify modifications made to the ARM since the last submittal, including any ARM/simulation adjustment factor(s) added since the ARM was last approved by DOE.

(iii) Approval must be received from the Department to use the ARM before the ARM may be used for rating split-system central air conditioners and heat pumps. If a manufacturer has a DOE-approved ARM for products also distributed in commerce by a private labeler, the ARM may also be used by the private labeler for rating these products. Once an ARM is approved, DOE may contact a manufacturer to learn if their ARM has been modified in any way and to verify that the ARM is being applied as approved. DOE will give follow-up priority to individual combinations having questionably high ratings (*e.g.*, a coil-only system having a rating that exceeds the rating of a

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coil-only highest sales volume combination by more than 6 percent).

(3) *Changes to DOE's regulations requiring re-approval of an ARM.* Manufacturers who elect to use an ARM for determining measures of energy consumption under § 429.16(a)(2)(ii)(B)(1) and paragraph (e)(1) of this section must submit a request for DOE to review the ARM when:

(i) DOE amends the energy conservation standards as specified in § 430.32 for residential central air conditioners and heat pumps. In this case, any testing and evidence required under paragraph (e)(2) of this section shall be developed with units that meet the amended energy conservation standards specified in § 430.32. Re-approval for the ARM must be obtained before the compliance date of amended energy conservation standards. (ii) DOE amends the test procedure for residential air conditioners and heat pumps as specified in appendix M to subpart B of part 430. Re-approval for the ARM must be obtained before the compliance date of amended test procedures.

(4) Manufacturers that elect to use an ARM for determining measures of energy consumption under § 429.16(a)(2)(ii)(B)(1) and paragraph (e)(1) of this section must regularly either subject a sample of their units to independent testing, *e.g.*, through a voluntary certification program, in accordance with the applicable DOE test procedure, or have the representations reviewed by an independent state-registered professional engineer who is not an employee of the manufacturer. The manufacturer may continue to use the ARM only if the testing establishes, or the registered professional engineer certifies, that the results of the ARM accurately represent the energy consumption of the unit(s). Any proposed change to the alternative rating method must be approved by DOE prior to its use for rating.

(5) Manufacturers who choose to use computer simulation or engineering analysis for determining measures of energy consumption under § 429.16(a)(2)(ii)(B)(1) and paragraphs (e)(1) through (e)(4) of this section must permit representatives of the Department of Energy to inspect for verification purposes the simulation

method(s) and computer program(s) used. This inspection may include conducting simulations to predict the performance of particular outdoor unit "indoor" unit combinations specified by DOE, analysis of previous simulations conducted by the manufacturer, or both.

[76 FR 12451, Mar. 7, 2011; 76 FR 24780, May 2, 2011]

§ 429.71 Maintenance of records.

(a) The manufacturer of any covered product or covered equipment shall establish, maintain, and retain the records of certification reports, of the underlying test data for all certification testing, and of any other testing conducted to satisfy the requirements of this part, part 430, and part 431. Any manufacturer who chooses to use an alternative method for determining energy efficiency or energy use in accordance with § 429.70 must retain the records required by that section, any other records of any testing performed to support the use of the alternative method, and any certifications required by that section, on file for review by DOE for two years following the discontinuance of all models or combinations whose ratings were based on the alternative method.

(b) Such records shall be organized and indexed in a fashion that makes them readily accessible for review by DOE upon request.

(c) The records shall be retained by the manufacturer for a period of two years from the date that the manufacturer or third party submitter has notified DOE that the model has been discontinued in commerce.

APPENDIX A TO SUBPART B OF PART 429—STUDENT'S T-DISTRIBUTION VALUES FOR CERTIFICATION TESTING

FIGURE 1—T-DISTRIBUTION VALUES FOR CERTIFICATION TESTING
[One-Sided]

Degrees of freedom (from Appendix A)	Confidence Interval			
	90%	95%	97.5%	99%
1	3.078	6.314	12.71	31.82
2	1.886	2.920	4.303	6.965
3	1.638	2.353	3.182	4.541
4	1.533	2.132	2.776	3.747